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IMAGE PROCESSOR

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IMAGE PROCESSOR

[Gazo shori sochi]

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[There are no amendments to this patent.]

Claims /1*

1. An image processor characterized in that it is equipped with

a conversion means which reads an image and converts it into an electric image signal,

a reading means which reads data written on a recording medium as text codes,

a raster conversion means which converts the text codes read by said reading means into raster data,

a page memory which stores the image signal obtained by the aforementioned conversion means or the raster data obtained by the aforementioned raster conversion means in amount equivalent to 1 page,

an image generation means which generates a copied image from the data stored in said page memory,

a recognition means which applies recognition processing to the aforementioned image signal and identifies a typeface from the recognition-processed data obtained,

* [Numbers in the right margin indicate pagination of the foreign text.]

a character recognition means which identifies characters from the aforementioned recognition-processed data and the aforementioned typeface, and

a substitution means which substitutes the characters identified by said character recognition means with a character font generation pattern.

Detailed explanation of the invention

Industrial application field

The present invention pertains to an image processor by which characters are identified from an image, and the signal read is encoded in order to generate a clean copy of the image using the corresponding character pattern.

Prior art

As so-called multi-media copier equipped with a built-in recording medium, such as a floppy disk, by which not only an image can be generated from data written on said recording medium onto a transfer paper, but an image on a document can also be written onto the recording medium, has been used for a long time.

In the case of this kind of multi-media copier, other than normal "copying from a paper document to other paper," "transfer from a recording medium to paper" is also possible. Accordingly, image information may be retrieved, and necessary information is selected to generate an image as needed.

Problem to be solved by the invention

As described above, in the case of this kind of multi-media copier, only necessary data can be transferred selectively from the recording medium onto paper in order to generate an image which suits a given purpose. /2

However, for example, when an image is generated from a document containing a hand-written part, the image generated from the hand-written part may become visually very unpleasant.

The present invention was made in light of this kind of status quo image processors, and its purpose is to present an image processor by which recognition processing and typeface recognition are applied to an image signal obtained by a conversion means, character recognition is further applied, and characters recognition-processed by a substitution means are substituted with a character font generation pattern in order to generate a clean copy of the image.

Means to solve the problem

In order to achieve the aforementioned goal, the present invention is configured with a conversion means which reads an image and converts it into an electric image signal, a reading means which reads data written on a recording medium as text codes, a raster conversion means which converts the text codes read by said reading means into raster data, a page memory which stores the image signal obtained by the aforementioned conversion means or the raster data obtained by the aforementioned raster conversion means in an amount equivalent to 1 page, an image generation means which generates a copied image from the data stored in said page memory, a recognition means which applies recognition processing to the aforementioned image signal and identifies a typeface from the recognition-processed data obtained, a character recognition means which identifies characters from the aforementioned recognition-processed data and the aforementioned typeface, and a substitution means which substitutes the characters identified by said character recognition means with a character font generation pattern.

Operation of the invention

In the present invention, when an image is read and converted into an image signal, the recognition means begins to operate to apply recognition processing to the image signal.

A type face is recognized from the recognition-processed data obtained through said recognition processing, characters are recognized by the character recognition means based on the recognition-processed data and the typeface, and the recognized characters are substituted with a character font generation pattern by the substitution means.

Application example

An application example of the present invention will be explained in detail below in reference to figures.

Figure 1 is an oblique view showing the configuration of the application example. In addition, Figure 2 is a block diagram showing the configuration of the application example.

In said figures, 1 is a reading device (scanner) serving as an input part of a digital copier to which the image processor of the present invention is applied, and image information on a document placed on a document table is converted into an electric signal (image signal) by means of a pickup device, such as a CCD.

In addition, 2 is a floppy disk memory device for recording/regenerating the image signal, 3 is a printer, and 4 is an operation display part.

Figure 3 is a diagram for explaining the configuration of scanner 1, and Figure 4 is a block diagram showing said configuration.

In Figures 3 and 4, 111 is a platen glass; 112 is a document; 113 is a sliding rail; 114 is a carriage; 115 and 116 are fluorescent lamps; 117 is a first mirror; 118 is a moving mirror; 119 and 119' are mirrors; 120 is a lens reading unit; 121 is a stepping motor; 122 123, and 124 are pulleys; 126 is a wire; 127 is a standard white plate; 128 is a lens; and 129 is a line sensor configured with a CCD.

In addition, 130 is an amplification circuit; 131 is an AD converter; 132 is a shooding [sic; shading] correction circuit; 133 is a binarization circuit; 134 is a CPU; 135 is a latch circuit; 136 is a dither pattern; 137 is a selector; 138 is a line buffer; 139 is an output buffer; 140 is an oscillation circuit; 141 is a line sensor driver circuit; 142 is a synchronizing signal generating circuit; 143 is a counter; 144 is a decoder; 145 is a ROM; 146 is a RAM; 147, 148, and 149 are I/O ports; 150 is a character isolating circuit; 151 is a character converter; 152 is a character generator; and 153 is a character recognition circuit.

Figure 7 is an oblique view for explaining the configuration of floppy disk memory device 2, and Figure 8 is a block diagram showing the configuration of floppy disk memory device 2.

In Figure 7, 210 represents an 8-inch floppy disk device, 211 represents a 5.25-inch /3
floppy disk device, and 212 represents a 3.5-inch floppy disk device.

As described above, 1 unit each of floppy disk drives of different types are provided in the application example, but said configuration is not always essential; and only 1 medium floppy disk device of a specific size and 1 or more document plates may also be utilized.

In addition, 213 is an electronic circuit for controlling, which corresponds to the part indicated by the broken line in the block diagram in Figure 8. 214 is an interface connector/cable to be connected to the scanner, 215 is an interface connector/cable to be connected to the printer, and 216 is an interface connector/cable to be connected to the operation display part.

As shown in Figure 8, floppy disk memory device 2 is based on a general microcomputer system and controls the respective peripheral parts via a so-called bus.

221 is a microprocessor which supplies signals for data, addresses, and control to bus 229. Floppy disk devices (will be referred to as FDD, hereinafter) 210, 211, and 212 are controlled physically (read and write) through FDD I/F 220. RAM 222 is a working RAM and activated by MPU 221. ROM 223 is the part where a program for the present system is stored, and the program is used to control FDDs 210, 211, and 212, scanner 1, printer 3, and page memory 228.

224 is a scanner I/F configured with a parallel data I/F and used to control the operation of scanner 1. Data is read from scanner 1 via S/P (serial-parallel data) converter 226 instead of said scanner I/F 224.

The data from S/P converter 226 are unfolded into page memory 228. Page memory 228 has a data capacity for holding a full-dot image for a sheet of printer output paper.

In addition, the image data in page memory 228 is transferred to printer 3 through P/S (parallel-serial data) converter 227. Printer I/F 225 is used to operate (print start, status, read, etc.) the printer and configured as a parallel data I/F. Said controlling electronic circuit 213 is connected to operation display part 4 via I/O port 228'.

As described above, floppy disk memory device 2 is used to record/regenerate the image signal; that is, it records an image signal (raster data) from scanner 1 and regenerates said recorded signal or records an image signal (raster data, vector data, text data, etc.) recorded using a different system. In addition, it contains page memory 228, scanner I/F 224, printer I/F 225, and an operation display I/F in order to control the entire device and to buffer the image signal.

Figure 9 is a diagram for explaining the configuration of printer 3, and Figure 10 is a block diagram showing the configuration of printer 3.

Said printer 3 constitutes an output part for the digital copier and generates an image on a recording member (paper, for example) based on the image signal by means of a laser beam printer.

In Figures 9 and 10, 301 is a photosensitive drum, 302 is a charger, 303 is a development part, 304 is a paper-feeder cassette, 305 is a paper carriage part, 306 is a resist roller, 307 is a transfer separation charger, 308 is a fixing device, 309 is a paper eject tray, 310 is a cleaning part, 311 is a laser device, 312 is a collimator lens, 313 is a polygon mirror, 314 is an f-θ lens, 315 is a mirror, and 316 is a beam detection mirror.

In addition, 317 is a beam position detector; 318 is a beam position detection circuit; 319 is a laser driver circuit; 320A and 320B are line buffer memories; 321 is an address counter; 323 is an input buffer; 324 is a CPU for controlling printer 3; 325 is a ROM where a program for /4 controlling printer 3 and a program for controlling an FGATE counter are stored; 326 is a RAM serving as a working memory for CPU 324; 327 is an I/O to which driving motor for printer 3, actuator of fixing heater, and a sensor for detecting the absence/presence of paper and paper size are connected; 328 is an I/O for the input of an LGATE, the number counted by the FGATE counter, and a signal for resetting counter 321; and 329 is an I/O for exchanging a control signal with the floppy disk device.

Figure 11 is a front view showing the configuration of operation display part 4.

In Figure 11, 460 is a standard operation part, 461 is a special operation part, 465 is a liquid crystal display, and 466 represents soft-keys. Standard operation part 460 is for the use of the "from paper to paper" function and configured with numeric keys 462 used for setting the number of copies, number display part 463, print start key 464, and copying requirement setting keys with a display part 470.

Special operation part 461 is used during a copy mode for recording to/regenerating from floppy disk device FD and configured with soft-keys (for data input) 466 and liquid crystal display 465.

As shown in Figure 8, meanings given to the soft-keys connected to the microcomputer system and data displayed on the liquid crystal display are all determined by the program in the microcomputer system via I/O port 228 provided in floppy disk memory device 2.

Next, operation of the present application example will be explained.

Document 112 is placed on platen glass 111 shown in Figure 3, and said document 112 is illuminated by light sources (fluorescent lamps) 115 and 116 provided on carriage 114 which travels on sliding rail 113.

Moving mirror unit 118 travels on sliding rail 113 provided with mirrors 119 and 119' and introduces an optical image of document 112 on the platen glass to lens reading unit 120 in combination with first mirror 117 provided on carriage 114.

As for carriage 114 and moving mirror unit 118, carriage 114 is driven at speed V, and moving mirror unit 118 is driven at speed 1/2V in the same direction by means of pooks [sic; pulleys] 122, 123, and 124 driven by stepping motor 121 via wire 126.

Standard white plate 127 is provided on the back side of the home position part of platen glass 111 in order to allow a standard white signal to be obtained prior to the beginning of the scanning of the document. Lens reading unit 120 serving as a reading lens system is configured with lens 128 and line sensor 129 attached to a reading substrate.

The optical image of the document transmitted by first mirror 117 and mirrors 119 and 119' is converged into an image on a light-receiving plane of line sensor 129 by lens 128. Line sensor 129 converts the shades of the document image into an electric signal (image signal).

Processing of the image signal will be explained using the block diagram in Figure 4. Said image signal is amplified by amplifying circuit 130, and A/D converter 131 converts each pixel into a multi-value digital image signal.

Said digital image signal is treated by shading correction circuit 132 in order to remove shades created by inconsistent illumination by the light sources, uneven distribution of the luminosity by the optical system (mirror lens), and uneven sensitivity of line sensor 129.

Character isolating circuit (OCR) 150 normalizes the image through expansion and compression, calculates the magnification of the restored image (the reciprocal of the magnification used for the expansion and the compression), and encodes the reference position during the character recognition in order to separate character data from image data. Then, it applies smoothing to the boundaries as a pre-processing treatment of a character sample to be recognized.

Figure 12 (a)-(c) shows plots showing the redundancy in handwritten characters, namely, katakana, hiragana, and Kanji characters, obtained through Fourier transformation.

Figure 13 is a flowchart showing the character recognition operation in the application example.

The operations in Steps S1 through S4 in Figure 13 are carried out by character isolating /5
circuit 150 in the aforementioned manner.

Then, the operations in Steps S5 through S9 are carried out by character recognition circuit 153, and character recognition circuit 153 separates katakana characters which have little redundancy from hiragana characters which are highly redundant as shown in Figure 12 (a)-(b). After they are encoded, the character data are sent to character generator 152.

At character converter 151, during the character recognition step, an open direction is assigned with a code using the closest pattern, connecting areas of the aforementioned image assigned with the code are extracted with respect to the same code, forcible area separation is applied to eliminate ambiguities between areas due to a deformation of the character, and barycentric coordinates of the remaining area are obtained after noise is removed in order to extract the characteristic in the open direction in Step S10 in Figure 13.

During the stroke characteristic extraction in Step S11, a directional code is determined using the next closest [pattern] (3 x 3) first. Then, during the extraction of the stroke, each of the 4 directions of the [pixels] integrated in 4-directions is extended as long as the pixels continue while preventing pixels with undetermined orientation, and a code is assigned (center coordinates and length).

The open direction code and the stroke code extracted from the character patterns are separated from each other in Step S12 in reference to a character table in order to recognize the character.

Figure 14 is a flowchart showing the character generation operation in the application example.

Once the aforementioned character code is input to character generator 152 in Step S15 as shown in Figure 14, and all radicals are confirmed in Step S16, the Kanji code is compared with a radical table in Step S17 in order to read a specific pattern code, and the presence/absence of a modification and the size are judged according to the condition of the connection between strokes in Step S18.

Then, upon confirming that all strokes have been processed in Step S19, the pattern code specified is input in reference to a stroke table in Step S20; and an address is determined, and the magnification is changed (in this case, expansion only) in Step S21 according to the reference position restoration magnification code attached to the character code in order to determined the position, size, and thickness of the stroke.

Said magnifying conversion processing S21 is carried out in accordance with the SUB flowchart in Figure 14, reference position on the x and y coordinates is calculated in Step S23, an offset value of the y coordinate is calculated in Step S24, and an offset value of the x coordinate is calculated in Step S25.

Then, upon advancing to Step S26, the character pattern is bit-mapped, and a judgment that only the magnification is repeated is made in Steps S27 and S28.

Finally, in Step S22, a modification is added to recreate the stroke. The character is recreated by repeating said operation for all strokes and radicals.

On the other hand, for image data recognized as non-character by character isolating circuit 150, a signal of an image, such as a character or a drawing manuscript, with clear distinction between white and black is converted into a fixed binary level by binarization circuit 133.

In other words, either a method (threshold) in which selector 137 is switched as the document selection switch at operation part 4 is operated in order to binarize the value arithmetically processed by CPU 134 at the pattern level of latch circuit (RAM) 135 or a method (dither) in which a dither pattern (ROM) 136 for an image which requires tones, such as a photo, is used for the binarization is utilized in order to obtain an optimal copy of the image.

As for the image data for which each pixel is binarized, assuming that the feeding resolution of an A3-size scanner for the A4 size (210 x 297 mm) is 400 dpi (dot/inch), data equivalent to 1 line, that is, serial image signal V/D, is output from buffer 139 to printer 2 via line buffer 138 configured with a RAM equivalent to 297 x 16 = 4752 dots.

Oscillation circuit 140 gives a reference signal to line sensor driver circuit 141 for driving line sensor 129 and synchronizing signal generating circuit 142 for [synchronizing] the image (raw) signal. Outputs of oscillation circuit 140 are counted by counter 143, and the count value is /6
input to decoder 144, and a pulse for driving line sensor 129 is generated by line sensor driving circuit 141 according to the decoded output. The other output of decoder 144 is used by synchronous generating circuit 142 to generate primary scan synchronizing signal LGATE in the direction of clock V_{CK} line (primary scan) and secondary scan synchronizing signal FGATE in the direction of a secondary scan in synchronization with the pixels.

Figure 5 is a diagram for explaining the relationship among the paper, the LGATE (primary scan signal), and the FGATE (secondary scan signal); and Figure 6 is a timing chart showing the timings of V_D (pixel signal), V_{ck} (clock), LGATE (primary scan), FGATE (secondary scan), and L_{sync} (synchronizing signal).

As shown in Figure 5, the length direction of the paper is covered by the secondary scan signal (FGATE), and the width direction is covered by primary scan signal (LGATE).

In addition, L_{sync} in Figure 6 is output from printer 3 and serves as a synchronizing signal for laser beam scanning. Pixel signal V_D is read data (image signal), and clocking is applied to it by image clock V_{ck}.

In Figure 4, CPU 134 (for example, 8036 by Intel) is operated using a control program written in ROM 145. It is configured with working memory RAM 146 and I/O ports 147, 148, and 149 in order to control all of scanner 1. I/O port 147 is used not only to turn ON/OFF the actuators for driving pulse motor 121 and document illuminating fluorescent lamps 115 and 116, but it is also used for detecting the home position switch of scanner 4 and the sensor for detecting a document. I/O port 149 engages in communication with the control circuit in floppy disk memory device 2 for parallel data transfer based on a hand-shake scheme.

Next, the operation of printer 3 will be explained.

In Figures 9 and 10, image signal V_D shown in Figure 6 is input in synchronization with synchronizing signals LGATE and FGATE and V_{ck} from floppy disk memory device 2 via input buffer 323 and written into line memory 320A or 320B. Line memories 320A and 320B are switched by means of a toggle signal from CPU 324, wherein, when line memory 320A is in a writing state, the other line memory 320B is in a reading states.

Counter 321 of the line memory counts using V_{CK} opened by LGATE and it is reset for reading addresses and writing them constantly. Memory 320B on the read side controls laser driver circuit 319 to turn on/off laser 311; and the light emitted from laser 311 is shaped into parallel light by collimator lens 312, is used to scan along the width of photosensitive drum 310 [sic; 301] by polygon mirror 313 in order to correct its warping distortion with -θ les 314, and is exposed over photosensitive body 301 via mirror 315.

On the other hand, for the image generating operation system, [the image] is transferred and placed on paper through the electronic photo processing shown in Figure 8. In other words, photosensitive drum 301 rotates in the direction indicated by the arrow, is charged by charger 302, exposed by aforementioned laser 311, and formed into an image by developer 303. The end of the paper carried from paper-feeder cassette 304 by paper carriage part 305 is matched with the end of the image while adjusting the paper finely by resist roller 306. The image developed by transfer separation charger 307 is transferred onto the paper as said paper is brought into contact with photosensitive drum 301, carried in the direction indicated by the arrow, fixed by fixer 308, and ejected onto ejection tray 309. On the other hand, residual toner on photosensitive drum 301 is recovered by cleaning part 310.

The aforementioned controls are carried out as CPU 324 is operated by ROM 325 containing a program. In addition, instructions for activation and suspension and an abnormality signal indicating a paper jam in printer 3, for example, from operation part 4 are sent via I/O 329 in order to control floppy disk memory device 2.

As described above, with the application example, the image signals obtained by line sensor 129 from the document are separated into character images and non-character images by character isolating circuit 150 and in character identifying circuit 153, character converter 151, and character generator 152, the character images are applied with typeface recognition and character recognition, and the recognized characters are further converted into character font generation patterns in order to generate an image in which the handwritten parts are rewritten /7 cleanly.

Therefore, when image processing is carried out using a printed document and a document containing handwritten parts, the handwritten parts are rewritten cleanly, so that a copy image which is very legible can be obtained or copied onto floppy disk 210, 211, or 212 in the form of character codes.

Effect of the invention

As described in detail above, with the present invention, an image processor by which a handwritten document can be rewritten cleanly by which, both "transfer from a floppy disk to paper" and "transfer from paper to a floppy disk" are enabled, and by which a clear copy image can be generated can be presented.

Brief description of the figures

Figures 1 through 14 are diagrams for explaining an application example of the present invention, wherein Figure 1 is an oblique view showing the entire configuration, Figure 2 is a block diagram showing the entire configuration, Figure 3 is a diagram for explaining the scanner, Figure 4 is a block diagram of the scanner, Figure 5 is a diagram for explaining the relationship among the paper, the LGATE (primary scan signal), and the FGATE (secondary scan signal), Figure 6 is a timing chart showing the timings of V_D (pixel signal), V_{ck} (clock), LGATE (primary scan), FGATE (secondary scan), and L_{sync} (synchronizing signal), Figure 7 is an oblique view for explaining the floppy disk memory device, Figure 8 is a block diagram showing the configuration of the floppy disk memory device, Figure 9 is a diagram for explaining the configuration of the printer, Figure 10 is a block diagram of the printer, Figure 11 is a front view of the operation display part, Figure 12 (a)-(c) shows plots showing the redundancy of handwritten characters, namely, katakana, hiragana, and Kanji characters, obtained through Fourier transformation, Figure 13 is a flowchart of the character recognition operation, and Figure 14 is a flowchart of the character generation operation.

1 … image reader; 2 … floppy disk memory device; 3 … printer; 4 … operation display device; 150 … character isolating circuit; 151 … character converter; 152 … character generator; and 153 … character recognition circuit.

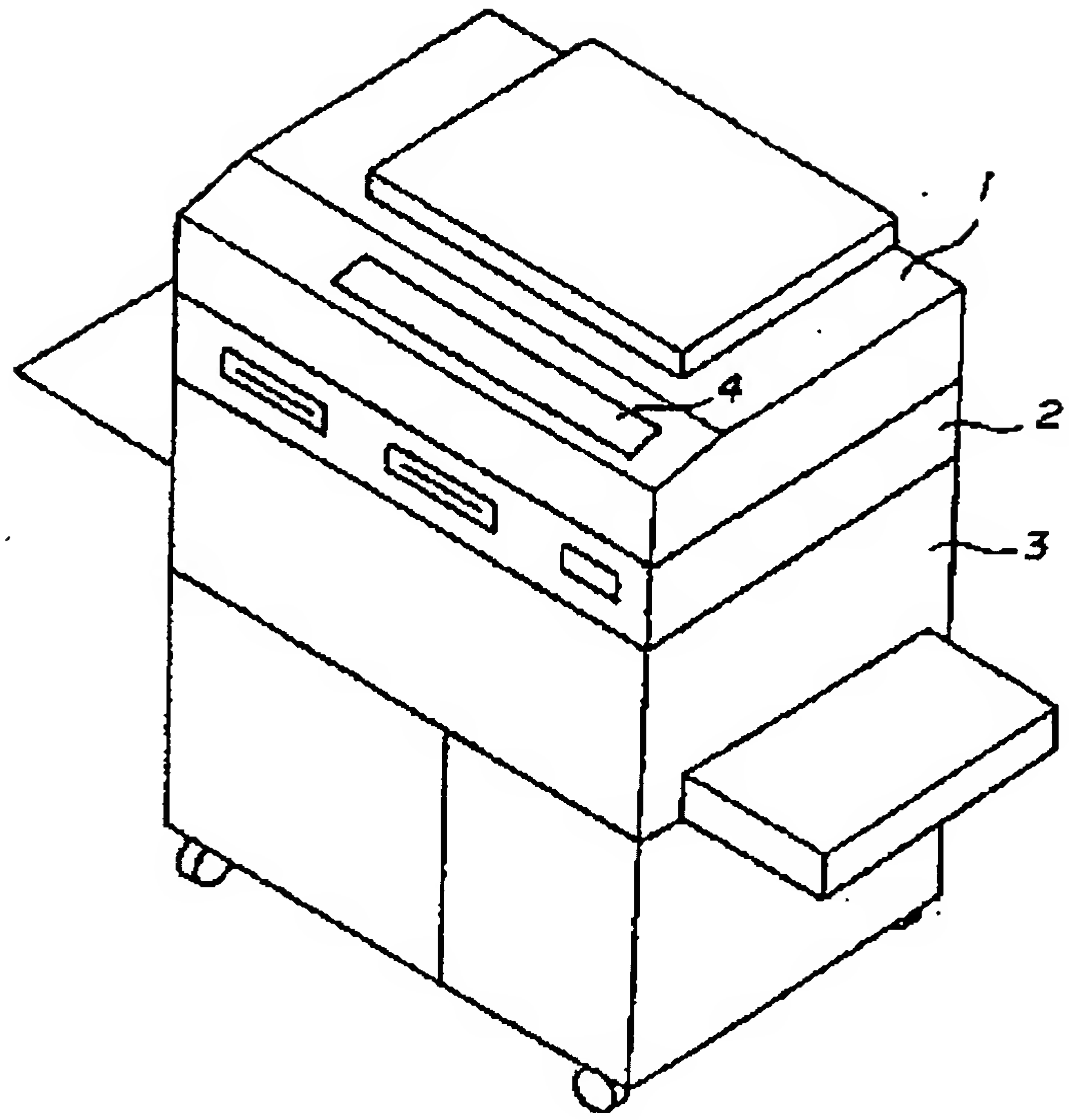

Figure 1

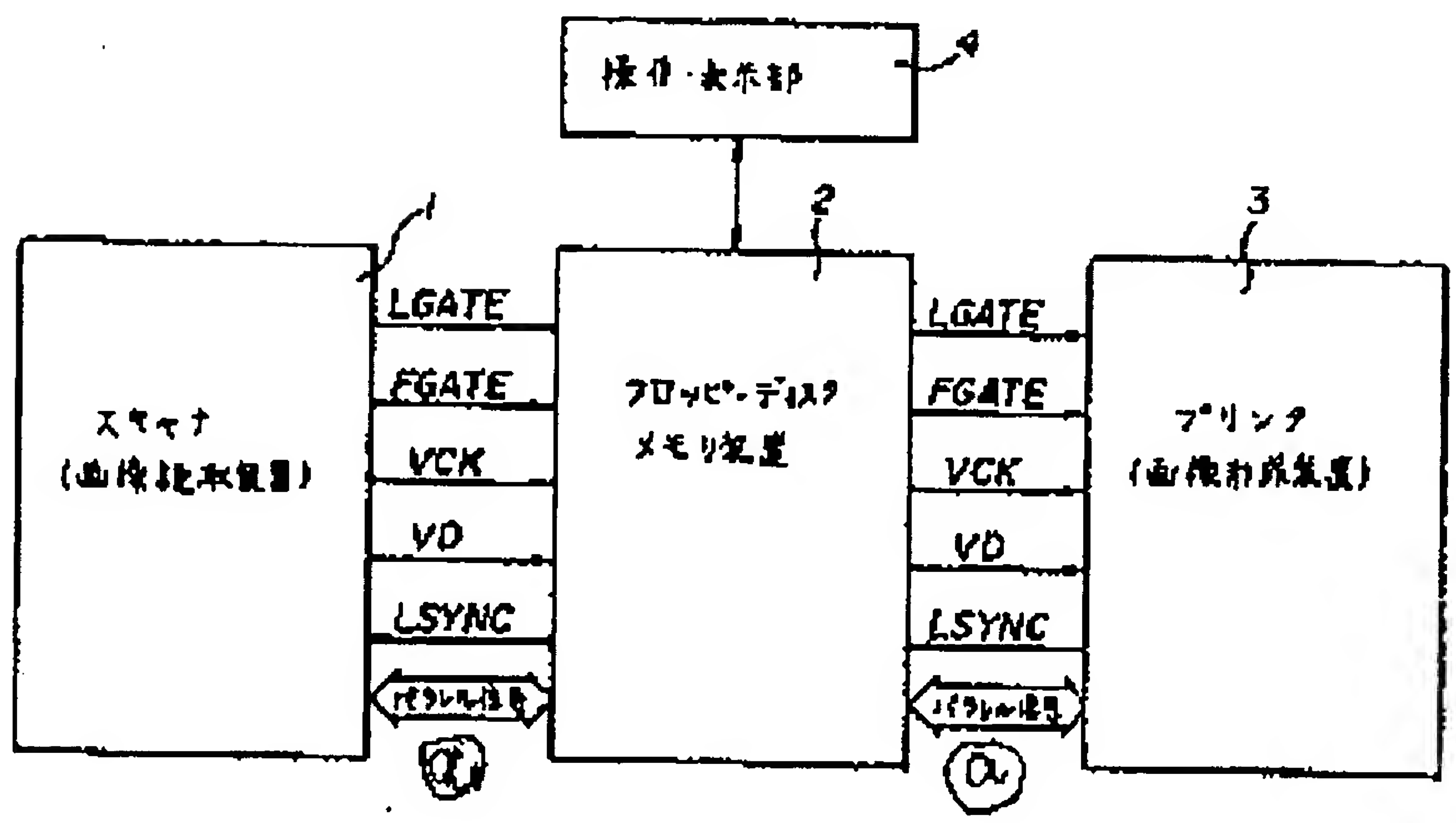

Figure 2

Key:	a	Parallel signal
	1	Scanner (image reader)
	2	Floppy disk memory device
	3	Printer (image generation means)
	4	Operation display device

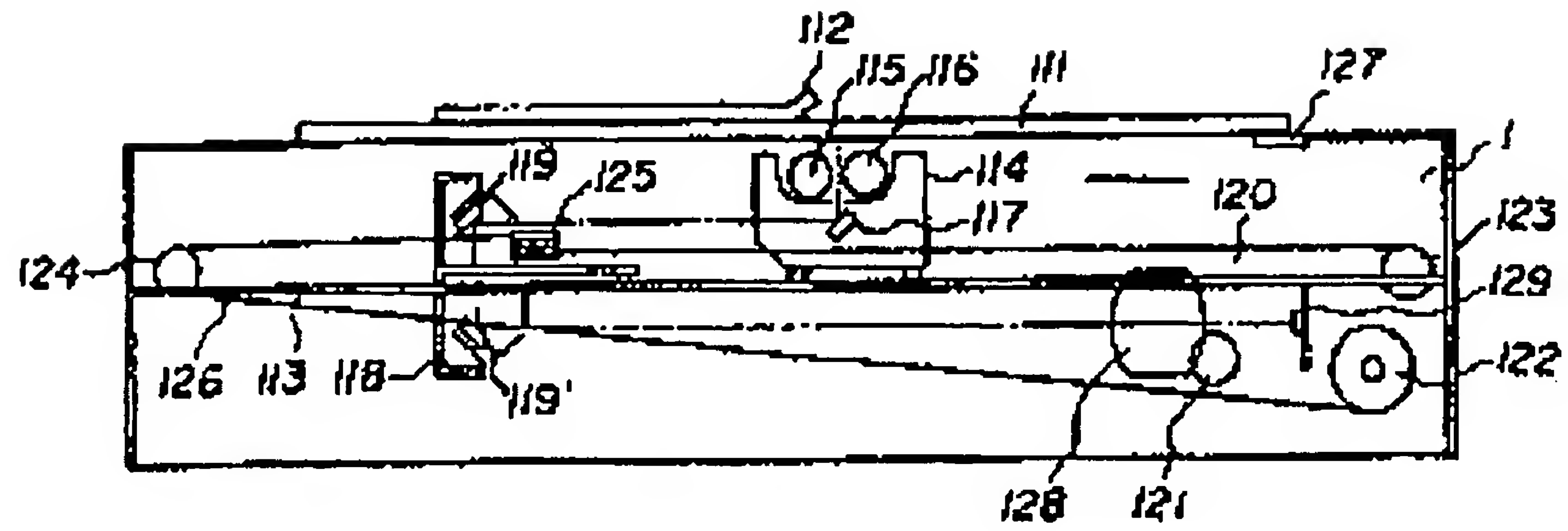

Figure 3

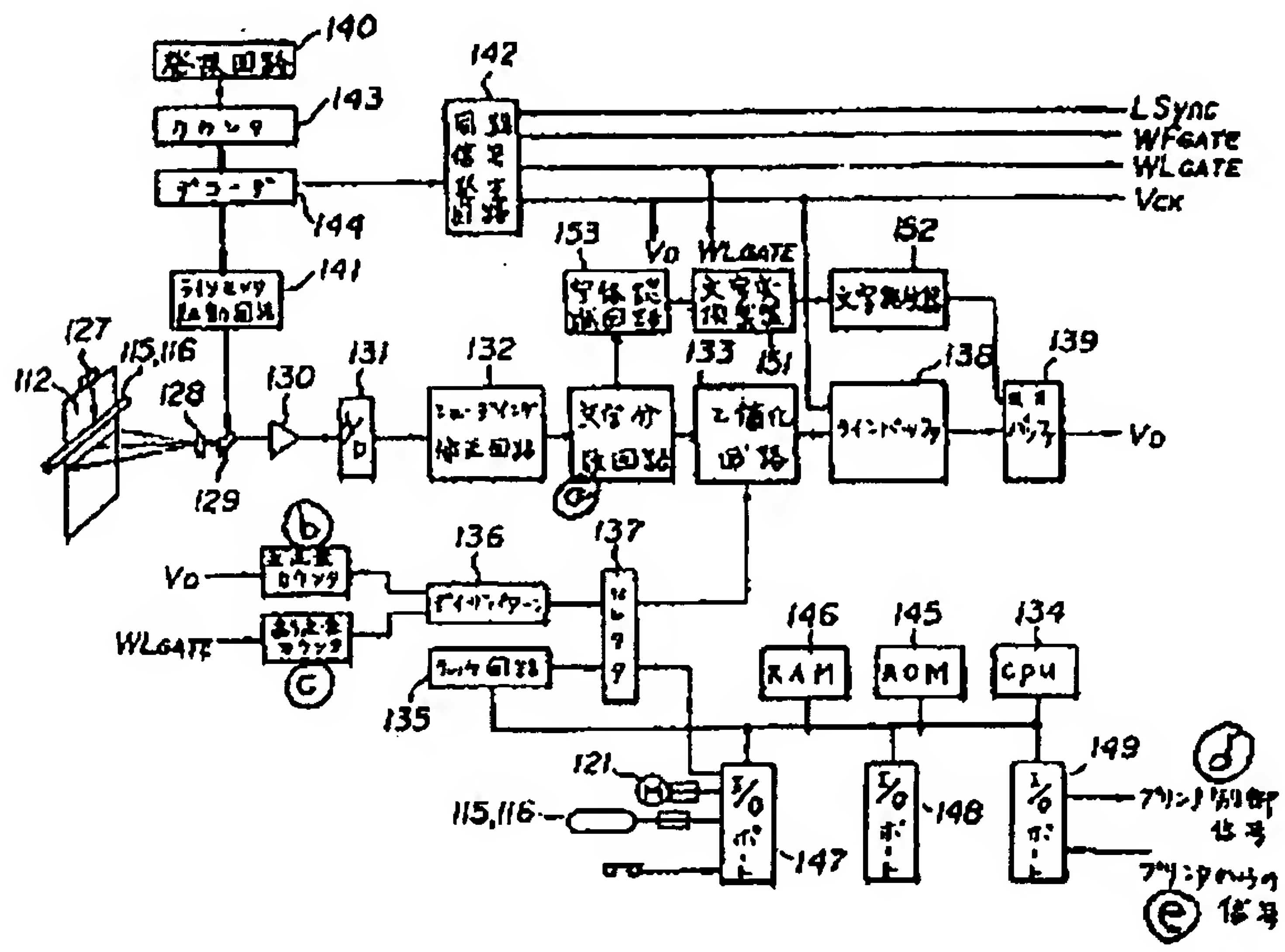

Figure 4

Key:

a	Character fraction circuit
b	Primary scan counter
c	Secondary scan counter
d	Printer control signal
e	Signal from printer
132	Shading correction circuit
133	Binarization circuit
135	Latch circuit
136	Dither pattern
137	Selector
138	Line buffer
139	Output buffer
140	Oscillation circuit
141	Line sensor driver circuit
142	Synchronizing signal generating circuit
143	Counter
144	Decoder
147, 148, 149	I/O port
151	Character converter

152 Character generator
153 Character recognition circuit

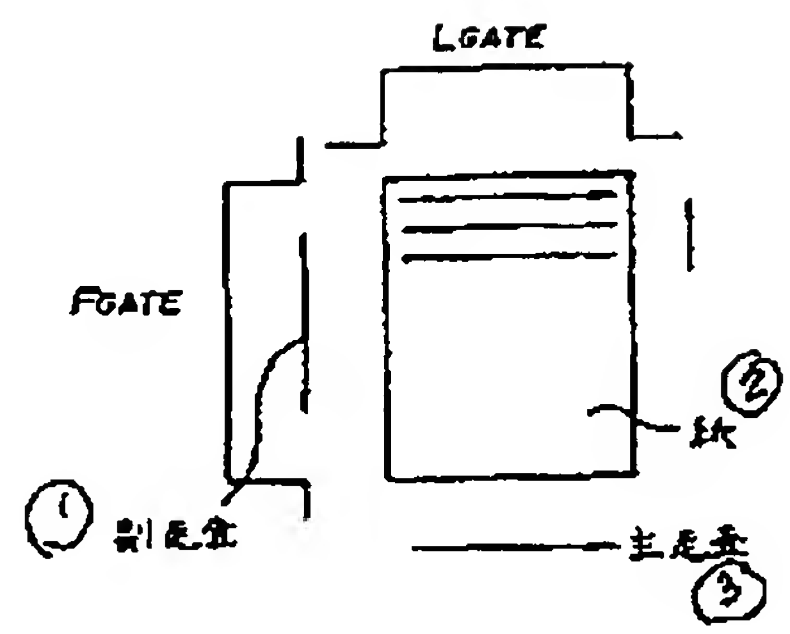

Figure 5

Key: 1 Secondary scan
2 Paper
3 Primary scan

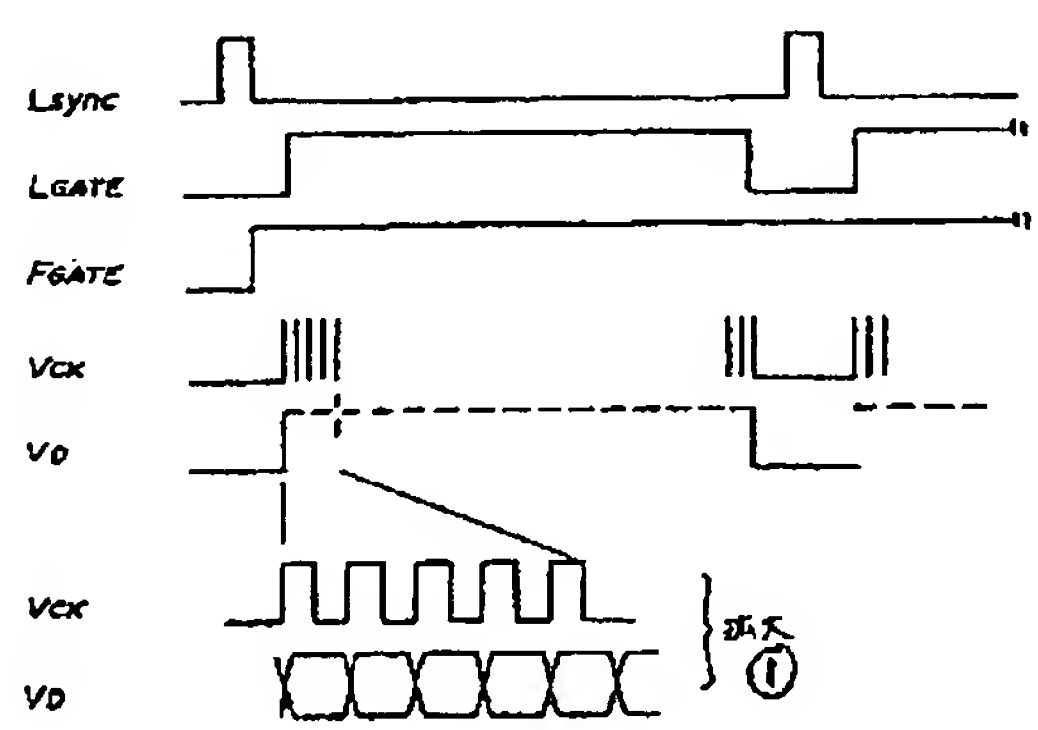

Figure 6

Key: 1 Epansion

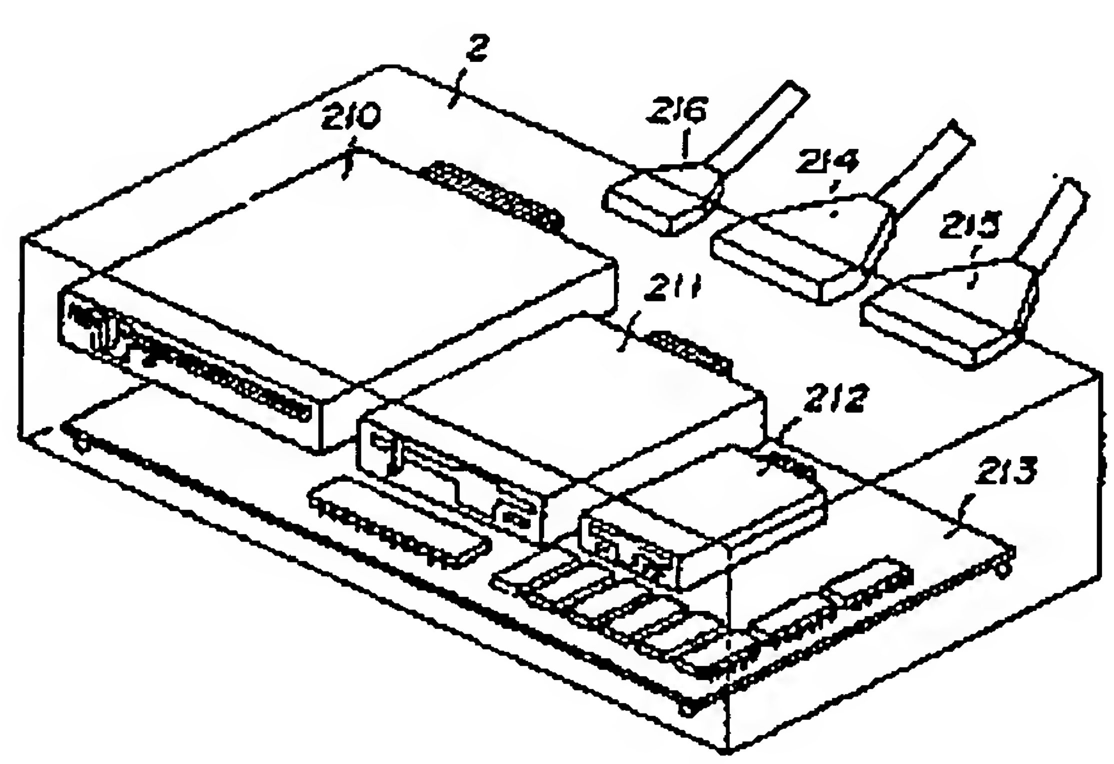

Figure 7

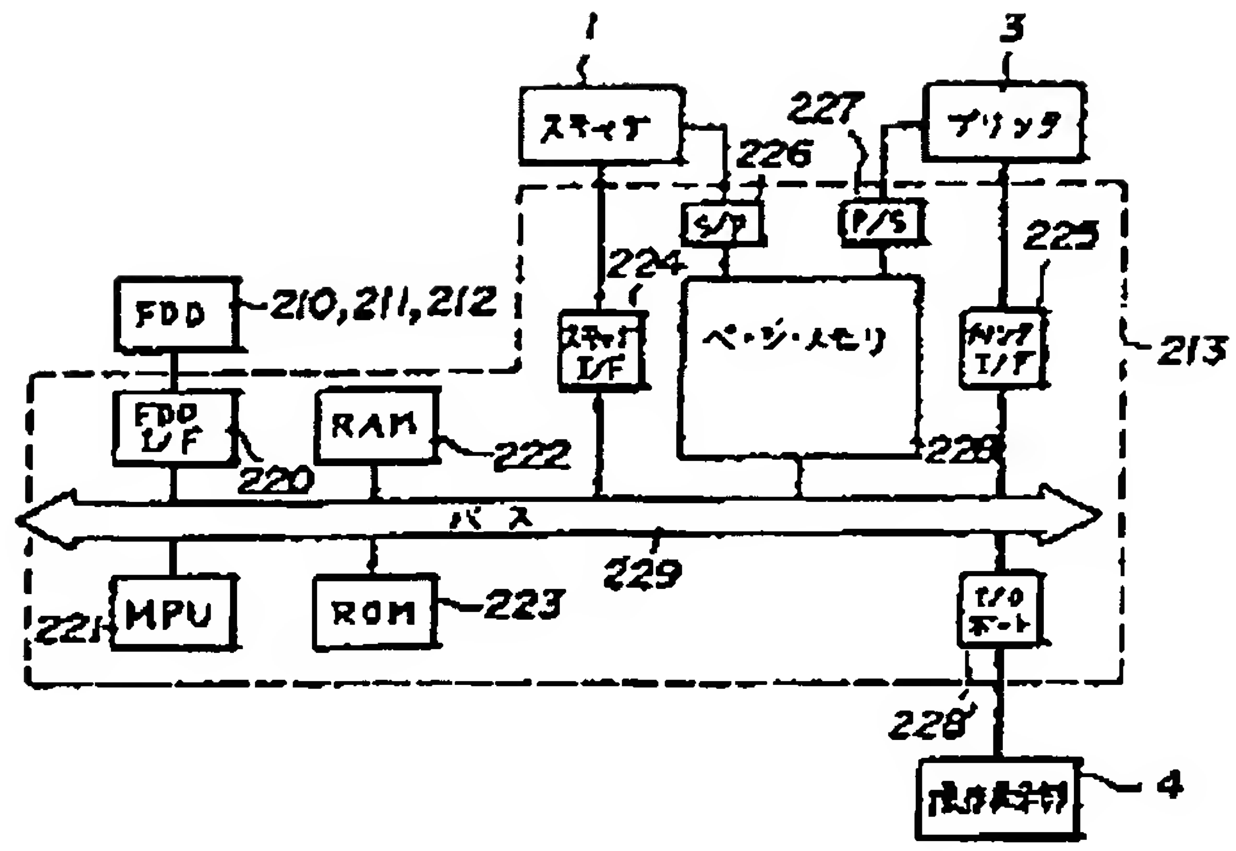

Figure 8

Key:

1	Scanner
3	Printer
4	Operation display device
224	Scanner I/F
225	Printer I/F
228	Page memory
228'	I/O port
229	Bus

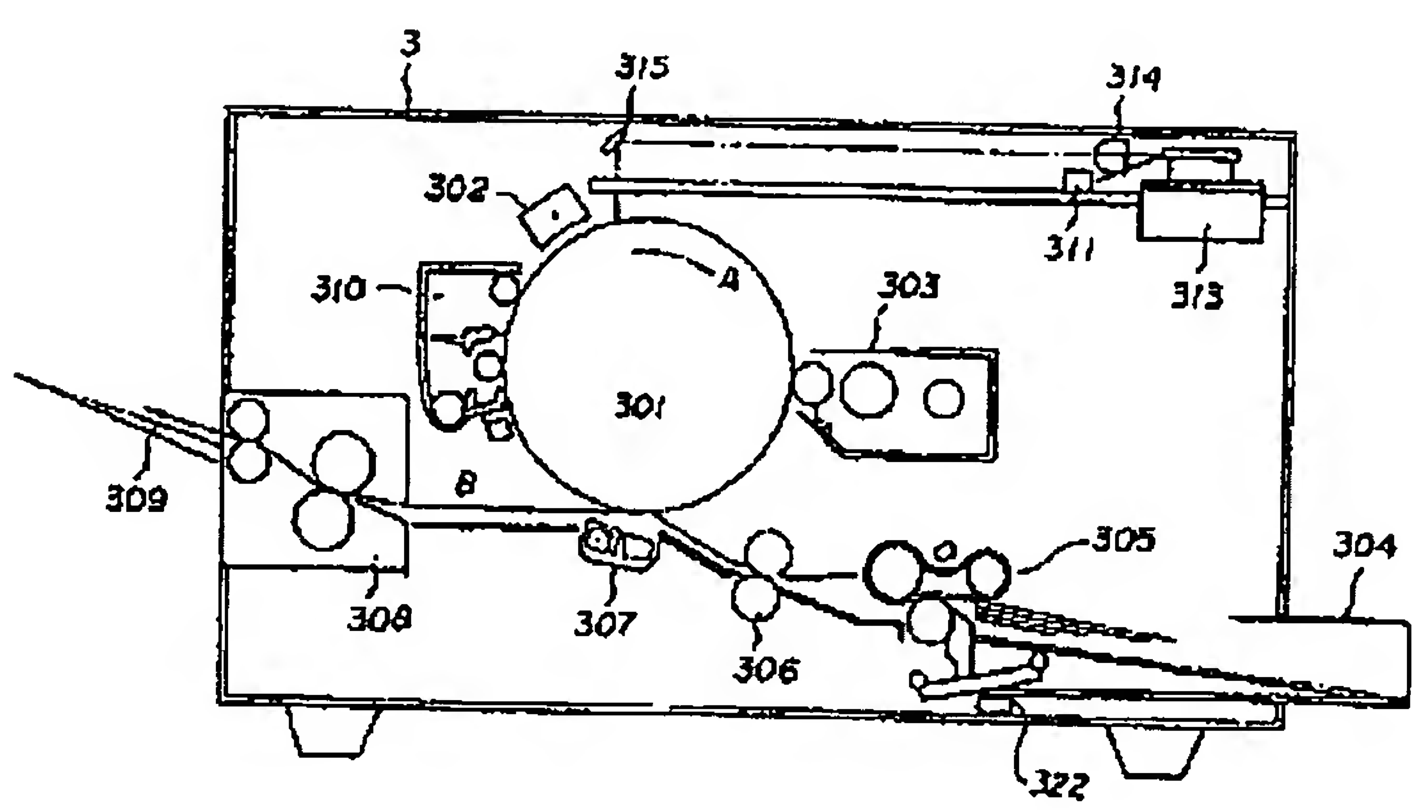

Figure 9

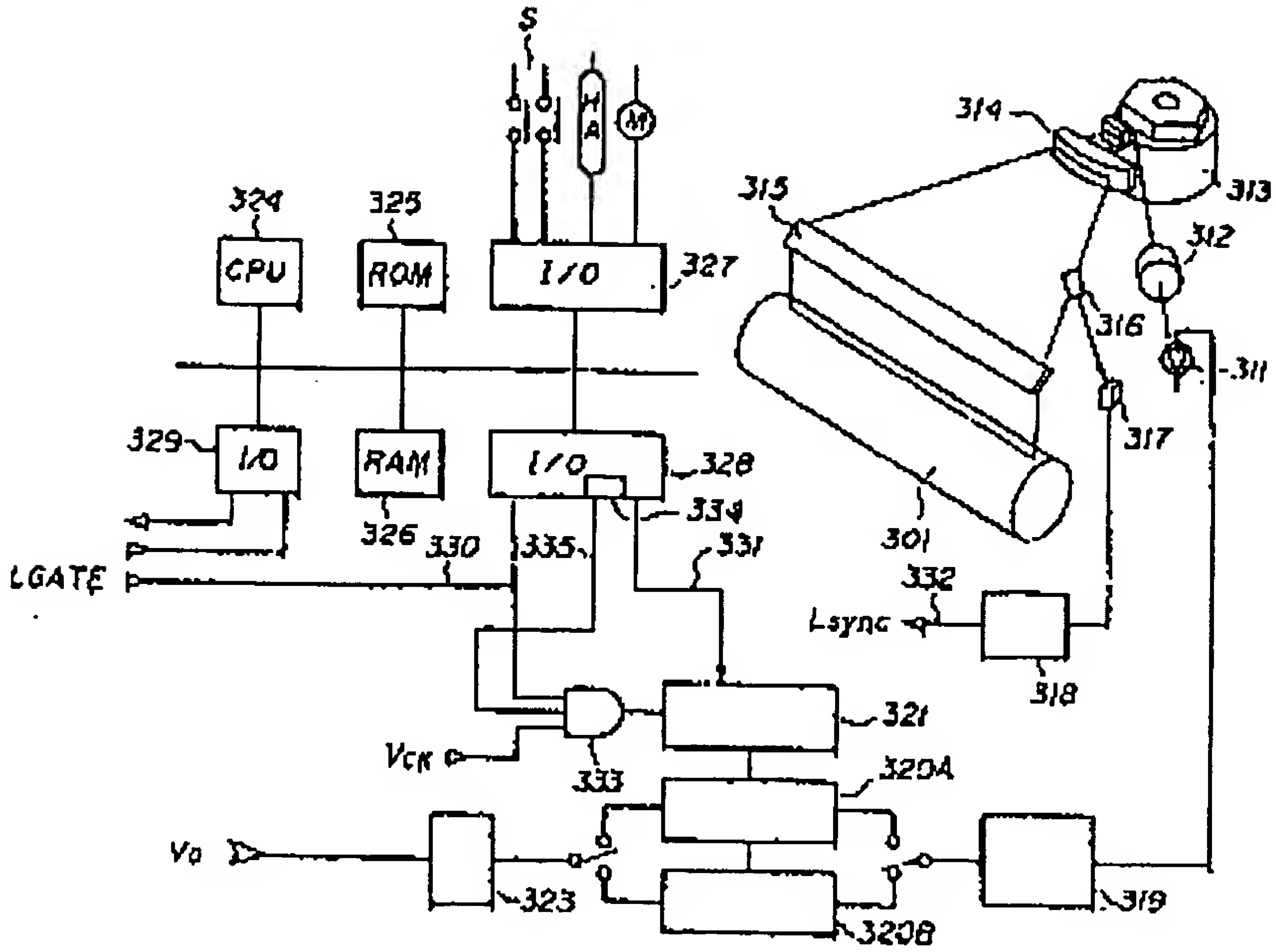

Figure 10

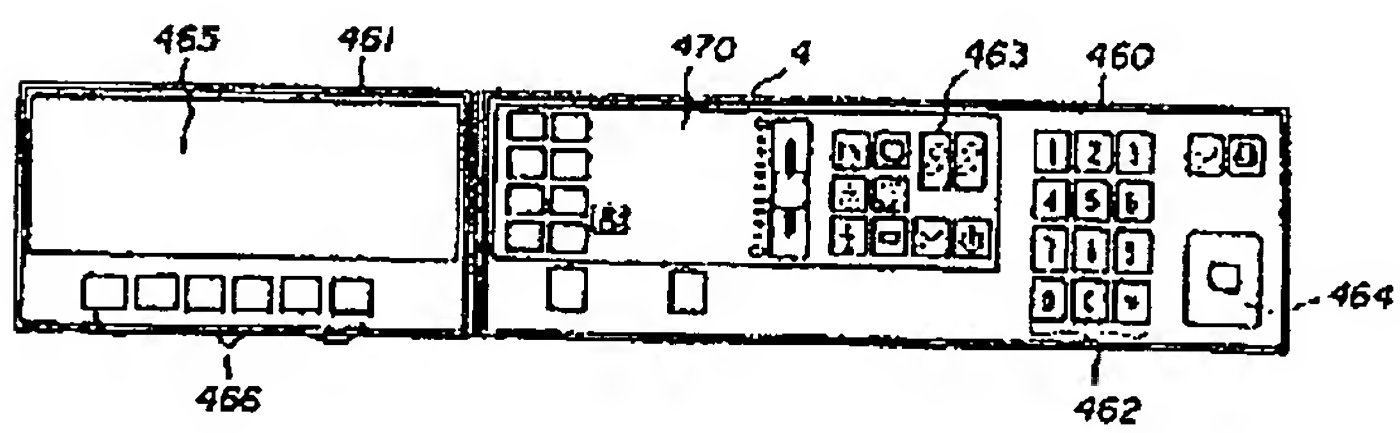

Figure 11

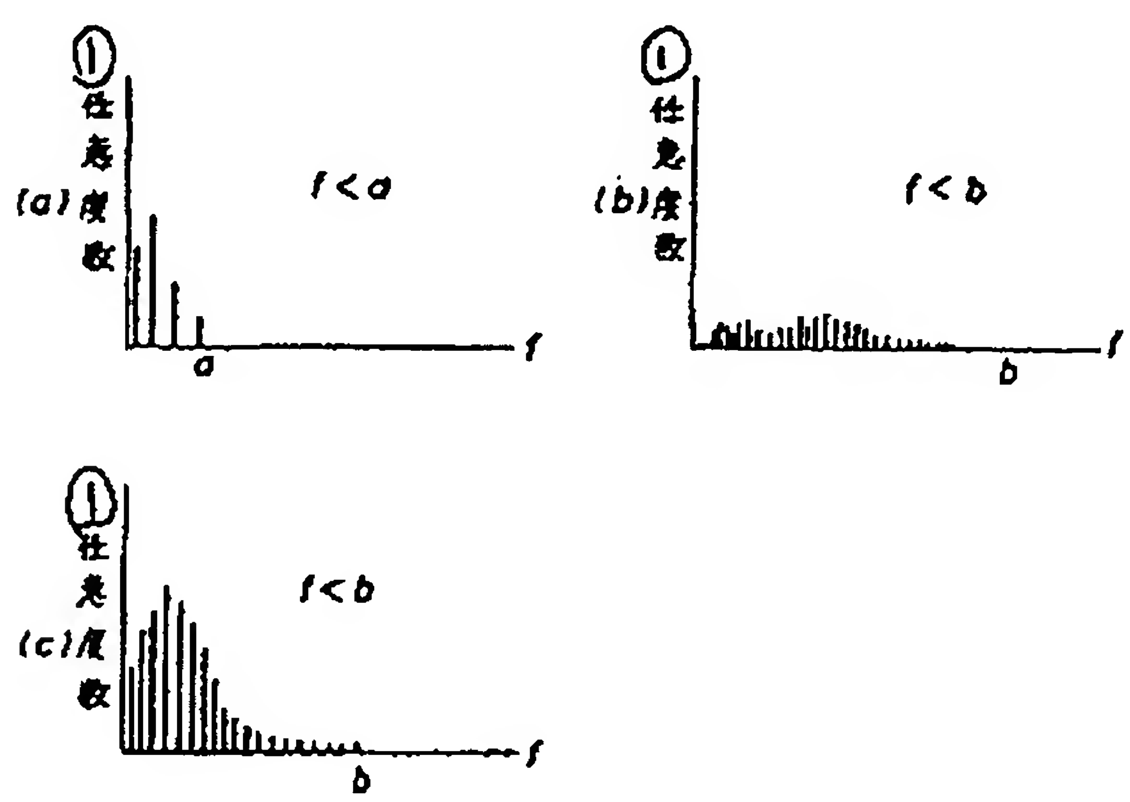

Figure 12

Key: 1 Arbitrary frequency

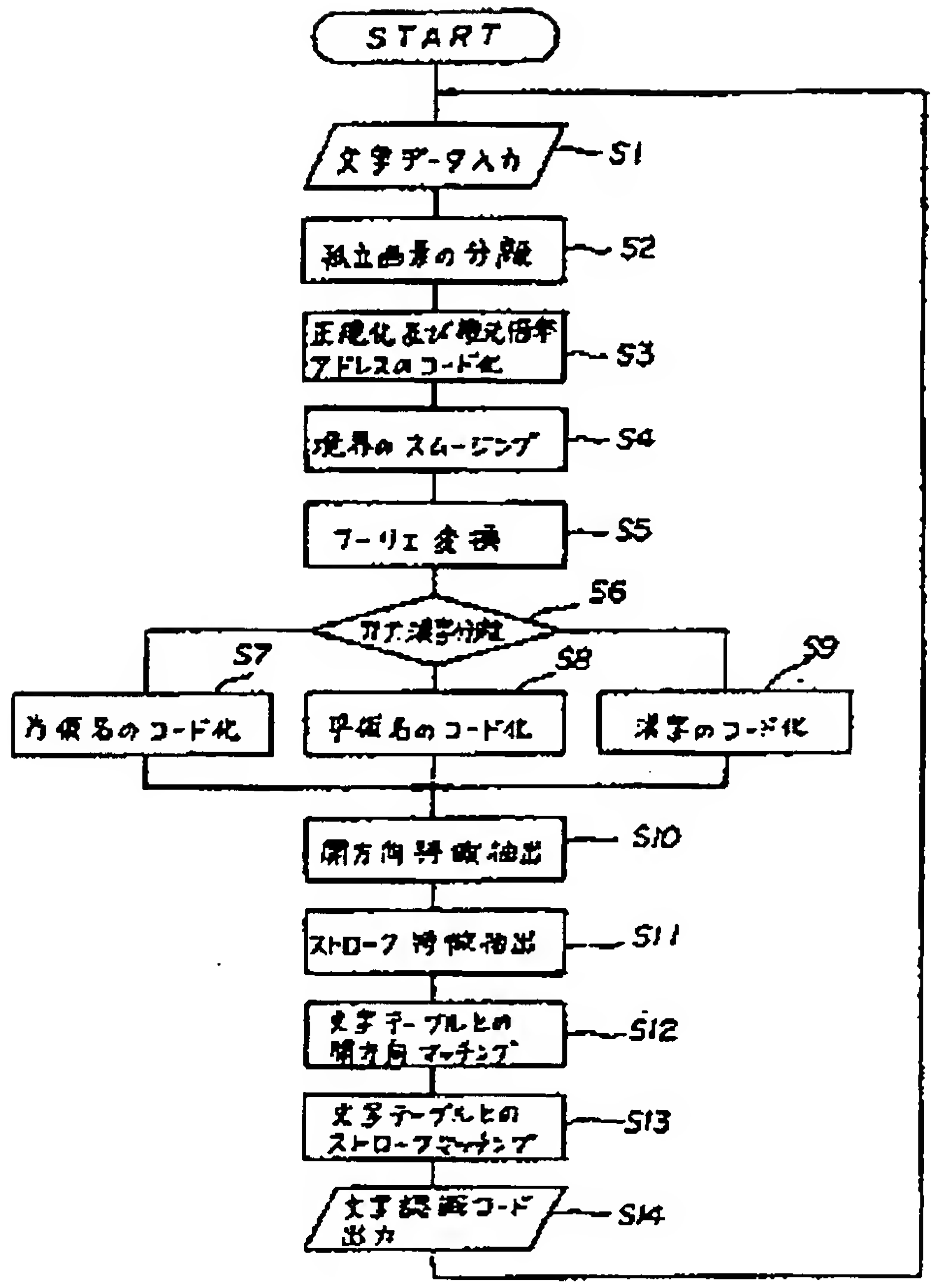

Figure 13

Key:

S1	Character data input
S2	Separation of isolated pixels
S3	Normalization, restoration magnification, and address encoding
S4	Smoothening of boundaries
S5	Fourier transformation
S6	Kana-Kanji separation
S7	Encoding of katakana
S8	Encoding of hiragana
S9	Encoding of Kanji
S10	Extraction of open direction characteristic
S11	Extraction of stroke characteristic
S12	Matching of open direction with character table
S13	Matching of stroke with character table
S14	Character recognition code output

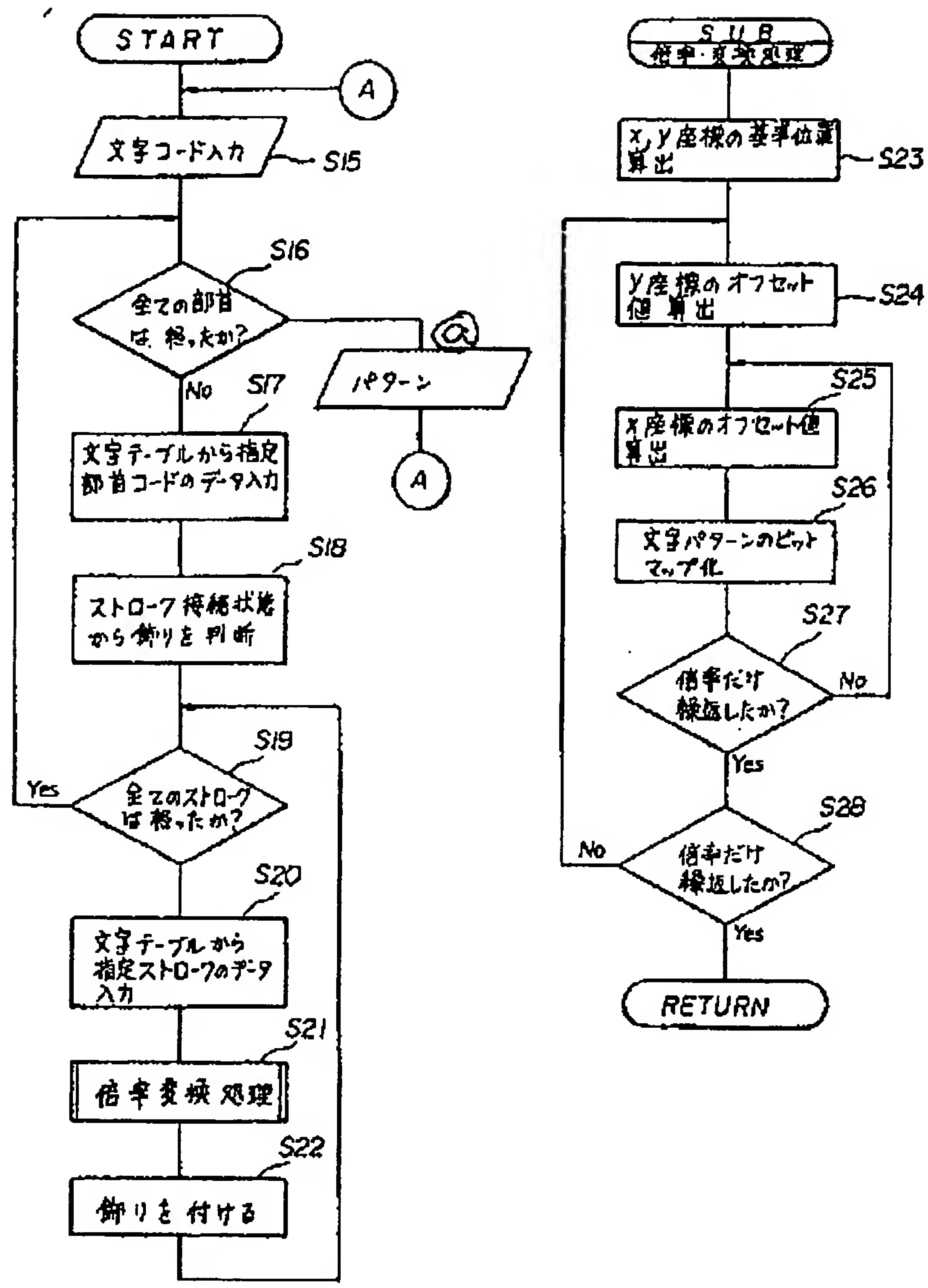

Figure 14

Key:
- a Pattern
- S15 Character code input
- S16 All radicals completed?
- S17 Input of data on specific radical code from character table
- S18 Judgment of decoration from stroke connection condition
- S19 All strokes completed?
- S20 Input of data on specific stroke from character table
- S21 Magnification conversion processing
- S22 Attach decoration
- SUB Magnification conversion processing
- S23 Calculation of standard position of x,y coordinates
- S24 Calculation of offset value of y coordinate
- S25 Calculation of offset value of x coordinate

S26 Bit-mapping of character pattern
S27, S28 Repeated as indicated by magnification?